

User Manual For DC Series MX06 40A Shelf

DC MX06 40A Shelf



The MX06 40A Shelf is a 19" compatible modular power plant capable of supplying up to 42A at -48V DC (54V). The unit contains a controller that can configure up to 4 x 10.5A rectifiers. Power distribution, Integral LVD contact and alarm signals are all included. Optional mounting brackets are offered to allow the system to be fitted in a 23" rack. Easy sub-assembly access and replacement allows for convenient and efficient maintenance.

Applications

- Cellular and PCS
- Distributed Networks
- PABX
- Customer premises
- Industrial
- Microwave
- Broadband Wireless
- Fibre

Features

- Integral LVD Contact
- Hot Plugable Fan Cooled Units
- Form C relay signals and visual alarms
- Single or 3-phase versions available with a wide input voltage range
- Battery temperature compensation of charging voltage
- Overvoltage and reverse voltage protection
- LED Meter available
- 2400W Output Power

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Issue Record

ISSUE	DESCRIPTION	DATE	APPROVED
Rev 01	New document	4 th JAN 2002	YES
Rev 02	Update	18 th FEB 2002	YES

1 General Information

1.1 Introduction

DC Power Plants from APC have unique features that make them easy to install, maintain, and upgrade. The rectifier units are modular and truly “hot-pluggable” into the shelf assembly without any separate ac wiring.

All system settings are controlled from the system control unit that provides monitoring and control functions for each component of the system as well as alarm outputs for system diagnosis and maintenance.

The APC international network of sales and service offices and qualified representatives provides sales assistance for proposals, purchases, and after-sales support.

1.2 Safety Precautions

The unit must be installed into an enclosure which conforms to the requirements of EN60950 : 2000, CAN/CSA 22.2 # 60950, UL60950 3rd Edition and be connected to comply with the standard. This includes but is not limited to providing external disconnection devices.

The end use equipment must be installed in accordance with the local building code and practices, by proper licensed installation personnel, taking into consideration all cautions and requirements detailed in this manual.

For proper guidance on the selection of any external disconnects and cabling requirements see the CEC and NEC codes or the local electrical code of the country of installation.

Before using the power system, carry out the following:

1.2.1 READ AND FOLLOW THE SAFETY PROCEDURES.

1.2.2 REFER TO THE FOLLOWING DOCUMENTS. ALL PROCEDURES MUST BE CARRIED OUT IN ACCORDANCE WITH THE INSTRUCTIONS THEREIN.

- EN60950 : 2000, CAN/CSA 22.2 # 60950, UL60950.
- MANUFACTURER'S INSTRUCTIONS
- MATERIAL SAFETY DATA SHEET (MSDS) FOR THE BATTERY
(If batteries are supplied with the system)
- HEALTH AND SAFETY AT WORK ACT, 1974 (UK)
- OCCUPATIONAL SAFETY & HEALTH STANDARDS (OHSA) (USA)
- ELECTRICITY AT WORK ACT, 1989 (UK)
- NFPA 70 NATIONAL ELECTRICAL CODE (USA)

- CEC Code C22.1-98 (Canada)
- CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH (COSHH) REGS
- MANUAL HANDLING REGULATIONS, 1993 (See Section 6)

1.2.3 BECOME FAMILIAR WITH THE HAZARDS ASSOCIATED WITH THE POWER SYSTEM AS DETAILED IN PARA 2.

1.2.4 CAUTION - BEFORE INSTALLING RECTIFIERS (POWER SUPPLIES) INTO AN UNPOPULATED SYSTEM SEE INSTALLATION INSTRUCTIONS IN SECTION 4.

1.3 Types of Hazards

The following hazards are present in the power system:

- ELECTRICAL VOLTAGE
- ELECTRICAL ENERGY
- HEAVY MASS

POTENTIALLY LETHAL VOLTAGES AND SOURCES OF HIGH ENERGY ARE PRESENT WITHIN THE POWER SYSTEM. EXTREME CAUTION MUST BE OBSERVED AT ALL TIMES. ACCESS TO THE INTERIOR OF THE SYSTEM FOR INSTALLATION, COMMISSIONING, MAINTENANCE AND REMOVAL AND REPLACEMENT PURPOSES IS LIMITED TO FULLY TRAINED SERVICE PERSONNEL ONLY. THIS SHOULD BE DONE WITH ALL POWER SOURCES DISCONNECTED EXCEPT WHEN ABSOLUTELY NECESSARY.

1.4 Inspection upon Receipt of Goods

1.4.1 General

APC has taken precautions in packing the power equipment for shipment to ensure its safe arrival; however, the entire shipment including any boxes or crates should be inspected upon receipt for evidence of damage that may have occurred during transit.

1.4.2 Visible External Damage

It is the responsibility of the person receiving the shipment to inventory and inspect all materials against the bill of lading or waybill provided IMMEDIATELY upon taking delivery while the carrier representative is still on site. Please be sure that all items are accounted for, including the correct number of pallets and the quantity of accessory and/or component boxes. Also, note any visible external damage that may have occurred during transit.

If damage has occurred or the quantity of items is not correct, then:

- 1) Make a descriptive notation on the delivery receipt before signing.
- 2) File a damage or shortage report with the carrier that delivered the shipment.

1.4.3 Concealed Damage

It is the customer's responsibility to unpack the power system and equipment received from APC and check for concealed damage. Within 15 days of receipt, check the materials received against the detailed packing list to verify that the quantity and condition are complete and satisfactory.

Again, note any damage to the internal packing material and/or material shortages. If damage or shortage is noted, then:

- 3) Request an inspection by the carrier
- 4) File a concealed damage claim; and/or
- 5) File a material shortage claim with your APC representative.

DELAY IN NOTIFYING THE CARRIER MAY RESULT IN LOSS OF RIGHT TO REIMBURSEMENT FOR DAMAGES OR LOSS.

If you are unsure about the appearance of a part while conducting the materials inventory and inspection, refer to the manual or contact the Customer Service Department of APC.

Should you have any questions concerning potential damages or should you experience a lack of cooperation from your carrier, please contact your APC representative, or call APC.

1.4.4 Return of Damaged Goods

Should equipment be damaged and require return to APC for repair, the APC service representative will provide instructions along with a valid returned material authorization (RMA) number to facilitate return of the damaged goods to the APC repair center.

It is important that the steps outlined in Section 1.4.2 and also Section 4 and 5 are followed carefully. Your APC representative will assist you, if required, in obtaining proper disposition of an initial delivery return issue; however, a valid RMA number must be obtained before returning any equipment to APC.

1.5 APC Worldwide Customer Support

Customer support for this or any other American Power Conversion (APC) product is available at no charge in any of the following ways:

- Visit the APC web site to find answers to frequently asked questions (FAQs), to access documents in the APC Knowledge Base, and to submit customer support requests.

<http://www.apc.com> (Corporate Headquarters)

Connect by links to APC web pages for specific countries and regions, each of which provides customer support information.

<http://www.apc.com/support/>

Submit customer support requests.

- Contact an APC Customer Support centre by telephone or email.

Regional Centres:

APC Headquarters (US and Canada)	(1) (800) 800 4272 (toll free) apctech@apcc.com
Latin America	(1) (401) 789 5735 (United States) apctchla@apcc.com
Europe, Middle East, Africa	(353) 91 702020 (Ireland) apceurtech@apc.com

- Local, country-specific centers: go to <http://www.apc.com/support/contact> for contact information.

Contact the APC representative or other distributor from whom you purchased your APC product for information on how to obtain local customer support.

1.6 Warranty Information

1.6.1 Limited Warranty

American Power Conversion (APC) warrants the DC MX06 40A Shelf to be free from defects in materials and workmanship for a period of two years from the date of purchase. It's obligation under this warranty is limited to repairing or replacing, at it's own sole option, any such defective products. This warranty does not apply to equipment that has been damaged by accident, negligence, or misapplication or has been altered or modified in any way. This warranty applies only to the original purchaser.

1.6.2 Warranty Limitations

Except as provided herein, American Power Conversion makes no warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

Some jurisdictions do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.

Except as provided above, in no event will APC be liable for direct, indirect, special, incidental, or consequential damages arising out of the use of this product, even if advised of the possibility of such damage.

Specifically, APC is not liable for any costs, such as lost profits or revenue, loss of equipment, loss of use of equipment, loss of software, loss of data, costs of substitutes, claims by third parties, or otherwise. This warranty gives you specific legal rights and you may also have other rights, which vary from state to state.

2 Product Overview and Technical Description

2.1 Specification

2.1.1 Rectifier

Parameter (per rectifier)	1TWF0500H54**
Approved Input Rating	115V or 230Vac
I/p Operating Range	103.5V to 264V
RMS Input Current	6.5A max @115V 3.6A max @230V
Approved Input Frequency range	45 – 65Hz
Turn-on Surge	< 10A
Turn-on Time	< 2 Seconds
Internal Fuse	7 amp 250V time lag
Power Factor	99 % typical, 90 % min
Output Voltage (Nominal)	54.5V dc
O/p Current (Rated)	10.5A @ 230V, 0-50°C 9A @ 230V, 50-65°C 9A @ 115V, 0-50°C 8A @ 115V, 50-65°C
Current Limit	105 % of rated
Over Volts Protection	59.5V dc \pm 0.5V
Power O/p (Rated)	500W @ 115V 600W @ 230V
Efficiency	83 % typical
Cooling	Fan Cooled, front to rear
Ambient Temp	-40 to 50°C (de-rate above 50°C)

Note :- See TWF0500 Rectifier datasheet for further or more detailed information

2.1.2 System AC Input

Input Voltage (Single phase)	90 - 264Vac (Live to Neutral)
(3 Phase Star)	208Vac, 380Vac, 400Vac or 415Vac (phase to phase)
(3 Phase Delta)	208Vac only (phase to phase)
RMS Current (max) single phase	26A @ 115V \pm 10%, 14.5A @ 230V \pm 10% (total)
RMS Current (max) 3 phase star	13A @ 208Vac, 7.2A @ 415Vac (per phase)
RMS Current (max) 3 phase delta	9.5A @ 208Vac (per phase)
Frequency	45 – 65 Hz
Efficiency	83% Typical
Harmonic Distortion	Complies with EN61000-3-2

2.1.3 System Output

Output Voltage Nominal	54.5Vdc
Voltage Adjustment Range	44 V – 57 V (Below 42V LVD contact opens)
Current Rating	42 A @ 230Vac, 36 A @ 115Vac, 28A @ 100Vac
Temperature Coefficient	-76mV/°C ±10% (over range 0°C - 50°C)
Current Limit	100% - 110% of Rated Current
Reverse Quiescent Current	Less than 100mA, Typically 50mA
Regulation	250mV max for any line or load condition
Over voltage	59.5V ± 0.5V (reset by interruption of AC Input)

2.1.4 Environmental

Temperature Range	-25°C to 50°C operating range
Humidity	85% non condensing

2.1.5 Safety Approvals

Approved to the following	CE marked to the European Low Voltage Directive 73/23/EEC amended by 93/68/EEC complies with BS EN60950:2000
	Certified to CAN/CSA 22.2#950-00 (NRTL/C UL1950 3rd Edition)

2.2 Display + LED's

3½ Digit LED Display	Switchable between “Volts” and “Amps”
“Volts”	System Output Voltage
“Amps”	Total Output Load Current
	Load Current = Rectifier Current – Batt Charge Current

4 LED Rectifier	Input Healthy	Green
	Output Healthy	Green
	Current Limit	Red
	Overvoltage	Red

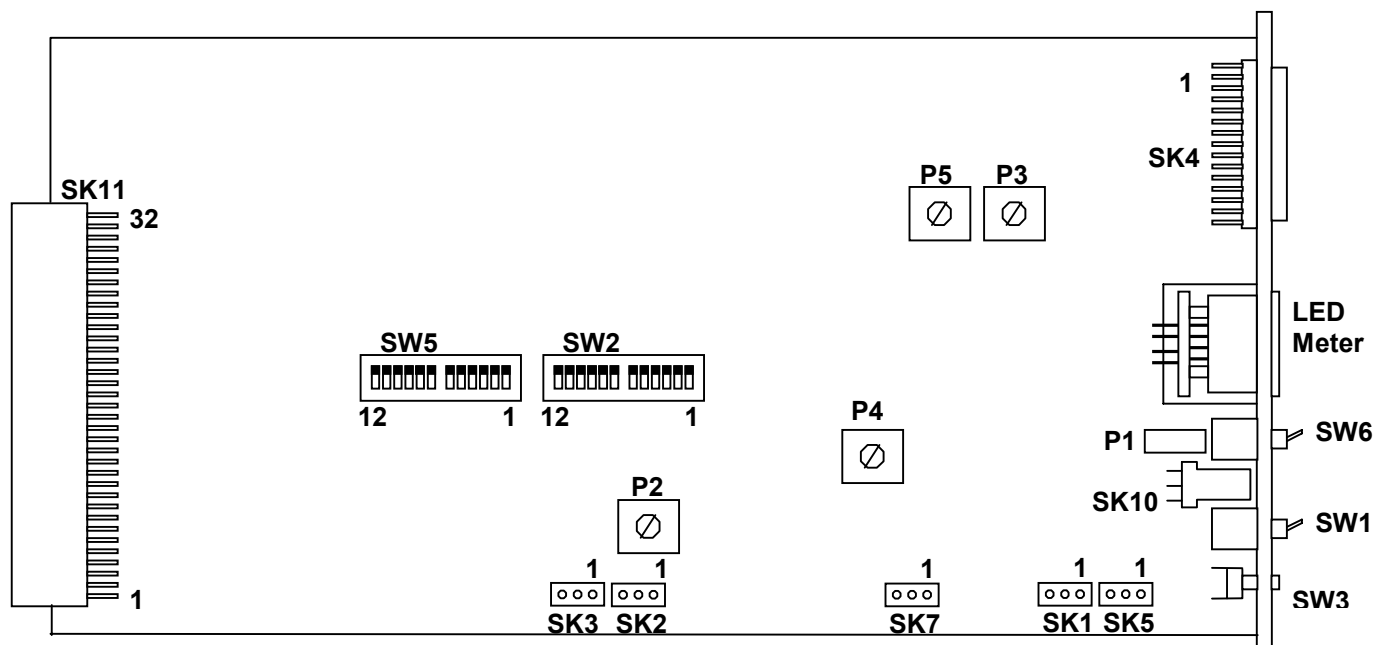
Single LED Rectifier	Rectifier Fail	Red
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Alarm Card LED's	Input Fail	Red
	Distribution Trip	Red
	Major Fault	Red
	Minor Fault	Yellow

NB/ LED's are lit when description is true.

2.3 Controller

2.3.1 Alarm Card Layout



Part Reference	Function	Adjustment
P1	Output Volts Adjust	Via Front Panel
P2	LVD Disconnect Volts Adjust	Factory Pre-set
P3	Meter Current Calibration	Factory Pre-set
P4	Meter Reading Zero Adjust	Factory Pre-set
P5	Meter Volts Calibration	Factory Pre-set
SK1	Link Pins 1+2 (27V), 2+3 (54V) (Temp Compensation)	Factory Pre-set
SK2	Link Pins 1+2 (27V), 2+3 (54V) (LVD Coil)	Factory Pre-set
SK3	Link Pins 1+2 (27V), 2+3 (54V) (LVD Circuit)	Factory Pre-set
SK4	Optional front panel access to signals	N/A
SK5	Link Pins 1+2 (27V), 2+3 (54V) (Voltage Programming)	Factory Pre-set
SK7	Link Pins 1+2 (27V), 2+3 (54V) (Meter Current)	Factory Pre-set
SK10	Link Pins 1+2 (Temp Comp), 2+3 (Non Comp)	Factory Pre-set
SK11	Main 64 Pin Connector	N/A
SW1	Battery connection (LVD) "ON", "AUTO" or "OFF"	Via Front Panel
SW2	Selects any of 11 alarms to give a "MAJOR" alarm	Remove Controller
SW3	Battery Test function (press and hold for test)	Via Front Panel
SW5	Selects any of 11 alarms to give a "MINOR" alarm	Remove Controller
SW6	Selects "Volts" or "Amps" reading for LED meter	Via Front Panel
LED Meter	Optional 3½ digit LED Display	N/A

2.4 Alarms

2.4.1 Available Alarms

To monitor the system status a selection of alarm outputs are available. Dependant upon the rectifiers fitted either 4 front panel LED's or a single LED give visual notification of a system fault. There is also a range of open collector transistor alarm outputs, which can be accessed at the rear of the shelf or on a front panel connector (selected models). Finally there are 2 sets of relay contacts that can be configured to represent 1 or more alarms selected by the user.

Below is a list of the available alarms along with their function and pin number.

Note/ Alarms marked with a * are not available if system is fitted with single LED rectifiers.

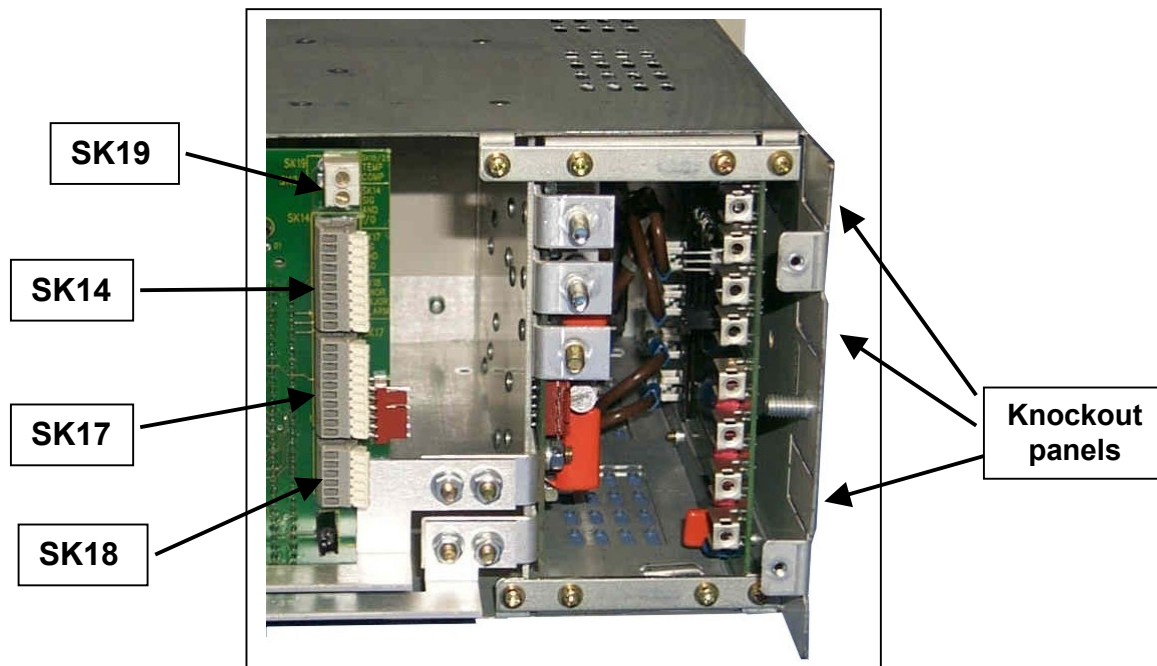
Alarm / User Outputs	Description	Rear Access	Front Access
Bus Voltage Low	System volts dropped to LVD set level +10%, LVD imminent	SK14-2	SK4-25
* Fan Fail	One or more of the Rectifier fans have stopped	SK14-3	SK4-24
2+ Rectifiers Fail	2 or more rectifiers giving output less than 31Vdc	SK14-4	SK4-5
Rectifier Fail	1 Rectifier giving output less than 31Vdc	SK14-5	SK4-6
Distribution Trip	1 or more fuse blown or breaker tripped	SK14-6	SK4-2
AC Fail	1 or more of the AC input feeds failed	SK14-7	SK4-1
* Over Current	1 or more rectifiers in current limit state	SK14-8	SK4-23
* Over Voltage	1 or more rectifiers tripped due to excessive o/p voltage (interrupt AC input or remove rectifier and refit to reset)	SK14-9	SK4-22
* Over Temperature	1 or more rectifiers tripped due to excessive internal temperatures (resets itself when cooled down)	SK14-10	SK4-21
Signal Common	Use to reference all alarms to	SK17-1	SK4-17
Current Share	Use for paralleling purposes only	SK17-3	SK4-16
Current Analogue	Analogue voltage representing load current (1V = 5A \pm 5%)	SK17-4	SK4-19
5V Auxiliary	Low current capability 5V supply for use with current limit programming.	SK17-5	SK4-15
Major Failure	'Minor' relay contact (closed for alarm)	SK18-1	SK4-11
" "	'Minor' relay contact (Common)	SK18-2	SK4-10
" "	'Minor' relay contact (open for alarm)	SK18-3	SK4-12
Minor Failure	'Major' relay contact (closed for alarm)	SK18-4	SK4-8
" "	'Major' relay contact (Common)	SK18-5	SK4-7
" "	'Major' relay contact (open for alarm)	SK18-6	SK4-9

Warning! All alarm outputs other than the relay contacts are open collector transistors. Each output has a max voltage rating of 60Vdc and a current sink capability of 20mA

2.4.2 Rear Access Alarms

To access the alarm outputs first ensure batteries are disconnected from the system by setting battery connection switch to "OFF" via controller front panel (see section 2.3) and by turning the external battery breaker off. The input mains supply must then be turned off by operating the local isolator or disconnection device. Remove the rear cover to leave the view as shown below. Labelled are the 3 signal output connectors SK14, SK17 and SK18 and also the temperature compensation connector SK19, where a thermistor is wired.

To use a particular alarm signal simply strip the ends of your alarm cables and enter into connectors by pushing down on respective lever, push in alarm cable and release lever to clamp cable. Cables should be routed through one of the knockout panels in the side of the shelf.



2.4.3 Front Access Alarms



The front access alarms are available from a 25 way 'D' connector socket (SK4) mounted in the controller front panel.

Alarms socket SK4

2.4.4 Major and Minor Alarms

In an MX06 40A Shelf, 9 of the available alarms can be set to show as a “Minor” or “Major” alarm. As standard the alarm outputs are open collector transistor outputs available from the connectors as detailed in the 2 previous sections. If an alarm is selected as a Minor or Major alarm it also lights the corresponding “Major” or “Minor” front panel LED and the “Major” or “Minor” relay contacts also change over. More than one alarm can be selected at once and each alarm can be selected as both Major and Minor if required.

The relay contacts are rated as follows:

AC Rating - 0.5A @ 125Vac
DC Rating - 1A @ 24Vdc
Max VDC - 0.6A @ 110Vdc

Alarm	Description	Major alarm selection	Minor alarm selection
Over Temperature	1 or more rectifiers tripped due to excessive internal temperatures (Resets itself when cooled down)	SW2-1	SW5-1
Over Volts	1 or more rectifiers tripped due to excessive o/p voltage (interrupt AC input or remove rectifier and refit to reset)	SW2-2	SW5-2
Over Current	1 or more rectifiers in current limit state	SW2-3	SW5-3
Fan Fail	One or more of the Rectifier fans have stopped	SW2-4	SW5-4
Bus Voltage Low	System volts below 48V LVD imminent	SW2-5	SW5-5
A.C Fail	1 or more of the AC input feeds failed	SW2-6	SW5-6
Fuse Fail	1 or more fuse blown or breaker tripped	SW2-7	SW5-7
2 or more Rectifier Fail	2 or more rectifiers giving output < 31Vdc	SW2-10	SW5-10
Rectifier Fail	1 Rectifier giving output less than 31V dc	SW2-11	SW5-11

See sections 2.3 for info on SW2 and SW5 location and relay contact pin-outs.

2.5 Customer Inputs

2.5.1 Current Limit Programming

Input	Description	Controller Type	Connector
Current Limit Program	Connect a DC voltage to this pin (referenced to signal common or –Ve output) to reduce the system output current limit point. Current limit is programmed down 1A per 1.5V program voltage. Max program voltage 7.5V.	Rear Access Front Access	SK17-2 SK4-20
5V aux	5V aux can be used to program down current limit level by linking to program pin.	Rear Access Front Access	SK17-5 SK4-15

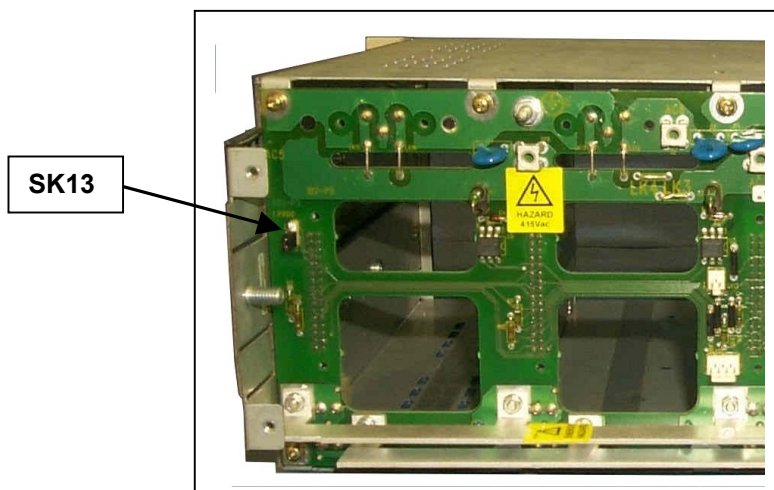
The system output current limit can also be set to either the standard “High” (100%) level or “Low” (70%) level by using **SK13**.

For “High” current limit level link pins 1 and 2 (default setting)

For “Low” current limit level link pins 2 and 3

Selecting “Low” current limit level will program down each rectifiers current limit level to roughly 70% of the default level. (See section 2.1.1 for default levels). This is the same as connecting the 5V aux pin to the current limit program pin as detailed above.

Note/ using both programming methods together will not double the effect



2.5.2 Output Voltage Programming

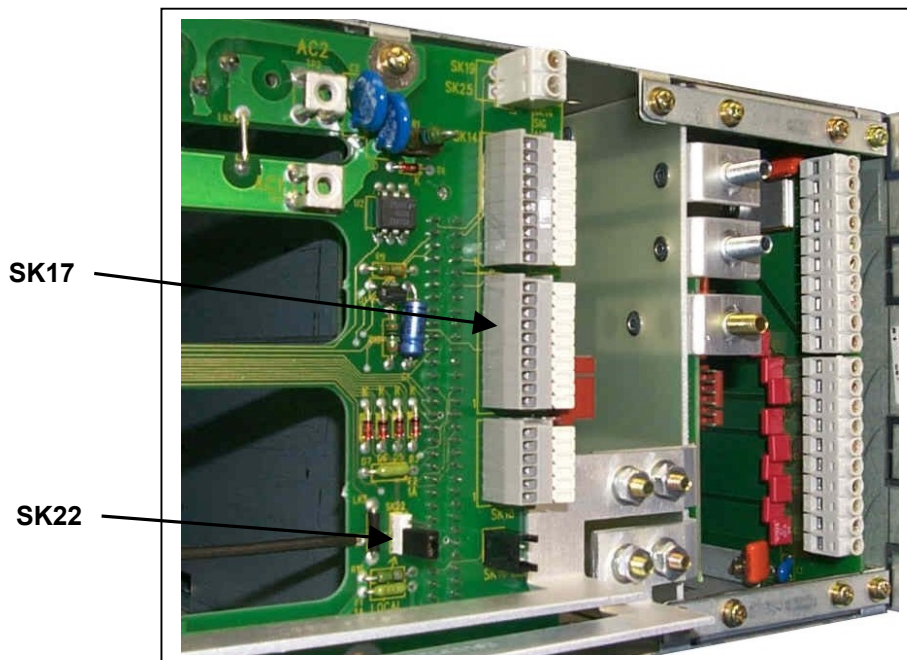
Input	Description	Controller type	Connector
Voltage Programming	Connect a DC voltage to this pin (referenced to signal common or –Ve output) to adjust the system output voltage. This pin floats at 2.5V nominal with respect to negative output (O/P @ 54.5V) Applying a DC voltage adjusts the output by –1V/V. (For 1V swing on program pin the output voltage changes by –1V) The programming voltage range is 0V – 14V, giving a max adjustment range of 57V to 43V. Note: See section 2.4 for SK4, SK17 location photo	Rear Access Front Access	SK17-7 SK4-18

2.5.3 Battery Test Function

Input	Description	Location
Battery Test	Front panel momentary push button. Push and hold drops output volts to 45Vdc. This is below battery float voltage and is used to check the batteries can supply the system load.	Push button mounted on controller front panel.

2.5.4 Enable Function

Input	Description	Location
Enable	Back-plane circuit board mounted 3-way Molex header. Link pins 1 and 2 with supplied link for "local" enable of rectifier outputs. Link pins 2 and 3 for "remote" enable. If "remote" enable SK17-1 and SK17-6 must be linked to enable rectifier outputs. System is set to "Local Enable" as standard	SK22 (mounted on back-plane board).



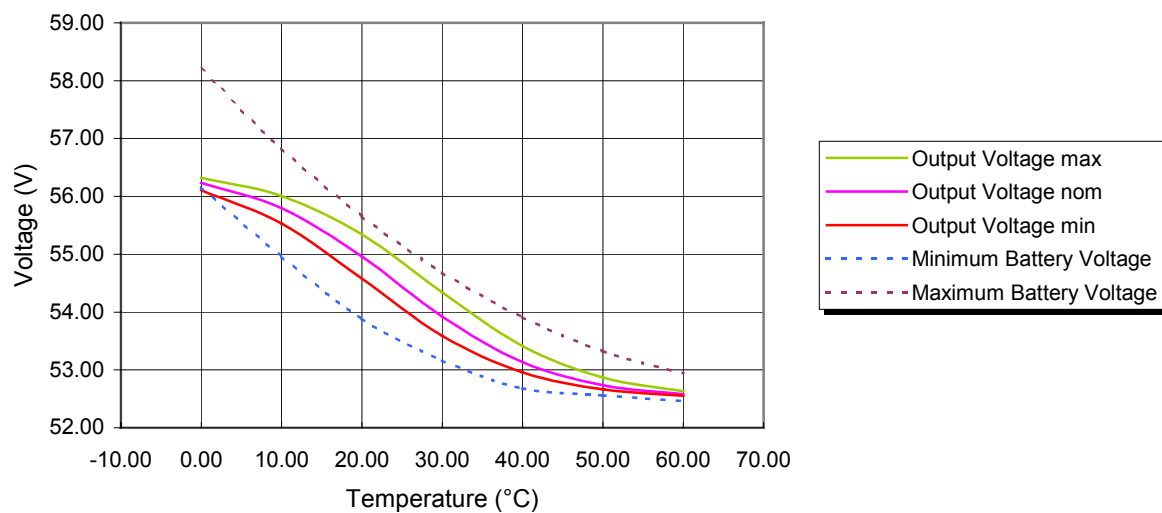
Note: Prior to accessing and making connections ensure batteries are disconnected from the system by setting battery connection switch to "OFF" via controller / alarm card front panel (see section 2.3) and by turning the external battery breaker off.

The AC input supply must then be turned off by operating the local isolator or disconnection device.

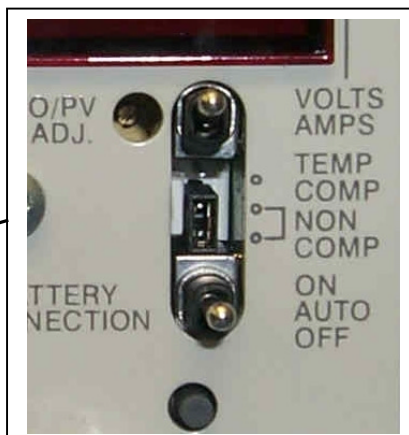
2.5.5 Temperature Compensation

Input	Description	Socket	Pin
Temp Compensation	This function allows a temperature probe to be used to automatically adjust the output voltage of the system. This ensures the charging voltage stays within the battery manufacturers recommended limits. To connect thermistor, simply enter striped wires into SK19 and screw to clamp (polarity not important). Check controller configuration link as explained below.	SK19	1 - 2
Note: See page 14 for SK19 location photo			

MX06 40A Calculated Temperature Compensation (54V)



System Controller



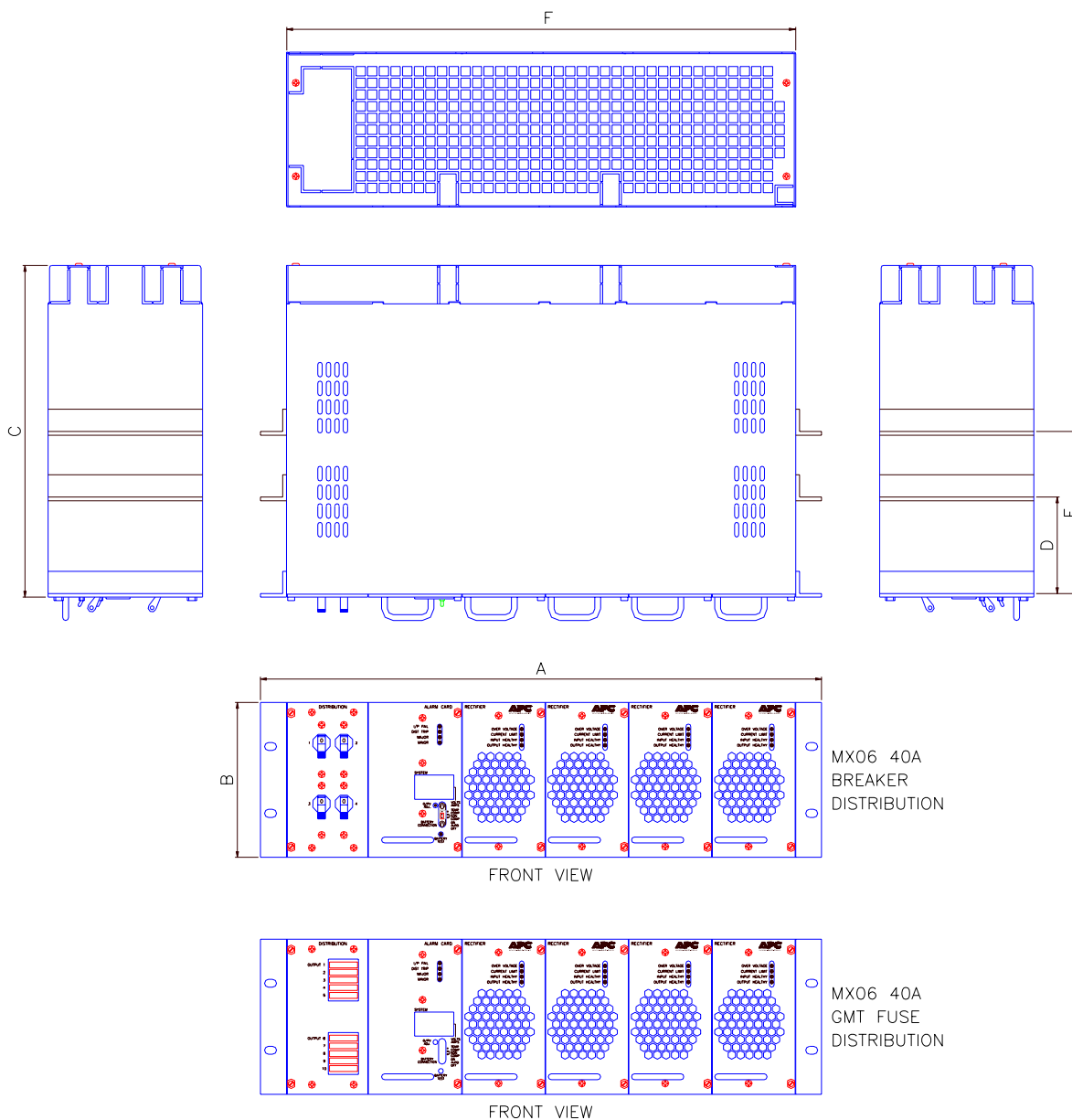
Link fitted on top 2 pins for Temp Comp

Link fitted on bottom 2 pins for no compensation (fixed o/p Volts)

2.6 Mechanical

2.6.1 Dimensions

Dimension	A	B	C	D	E	F
Length	482.6mm (19in)	132.5mm (5.22in, 3U)	283.6mm (11.17in)	82.5mm (3.25in)	138.5mm (5.45in)	438.2mm (17.25in)



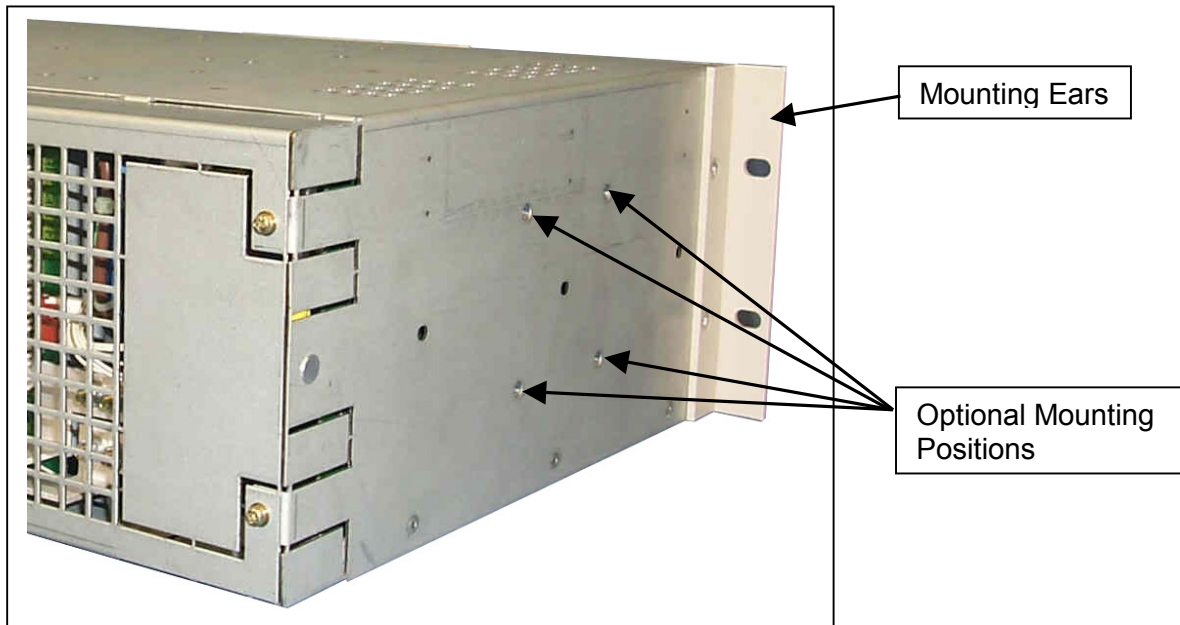
2.6.2 Weight

Item Measured	Shelf + Dist + Controller	Single Rectifier	Full System
Weight (Kg)	7.65	1.75	14.70
Weight (lbs)	16.85	3.85	32.35

2.6.3 Mounting Options

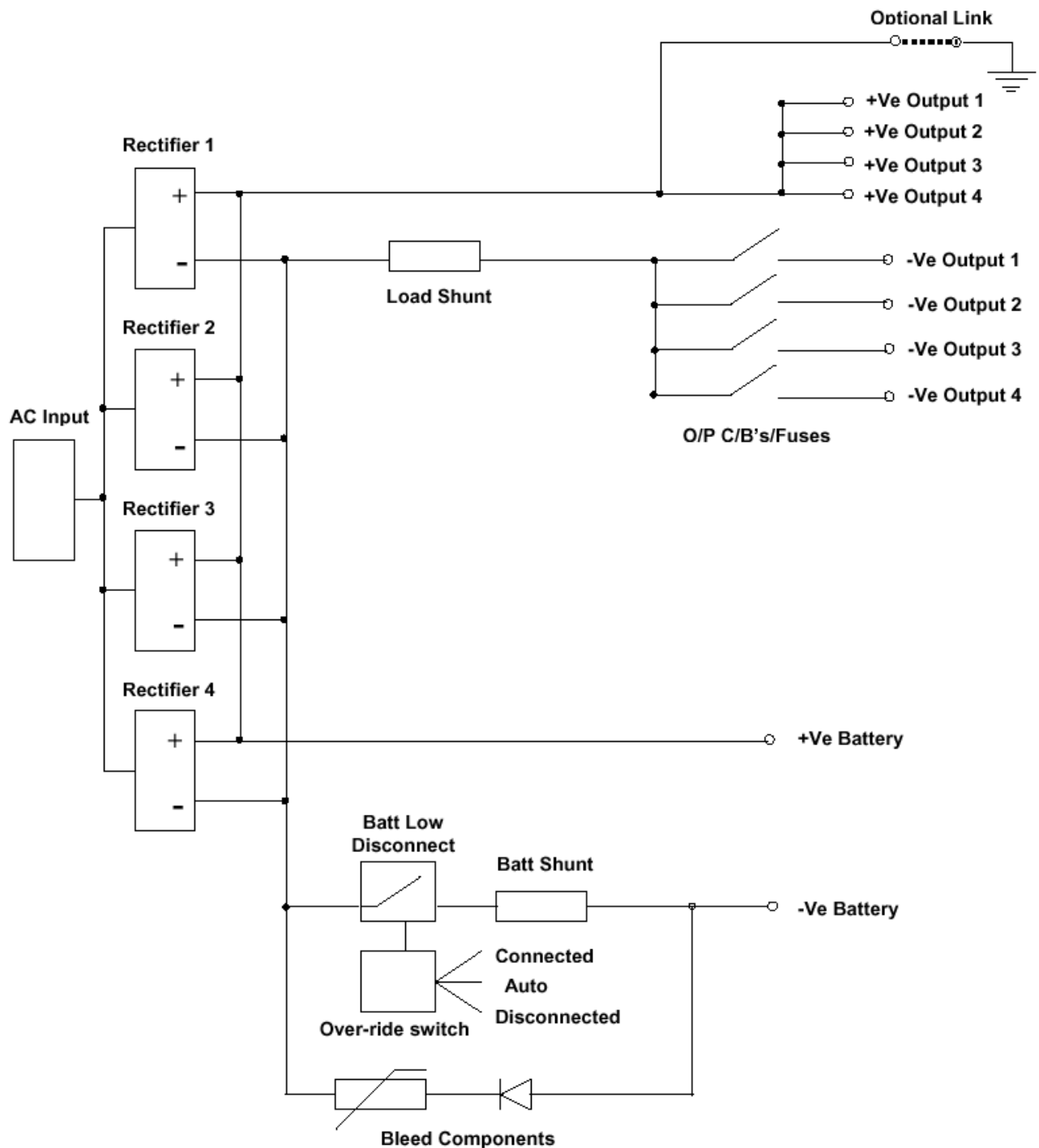
The MX06 40A Shelf has 3 positions for mounting ears. If mounting ears were ordered with the system they will be fitted in the front position as standard. The 2 alternative mounting positions are shown below. The end user can simply unscrew the ears and re-fit in the desired position.

Ensure all screws are re-tightened sufficiently.

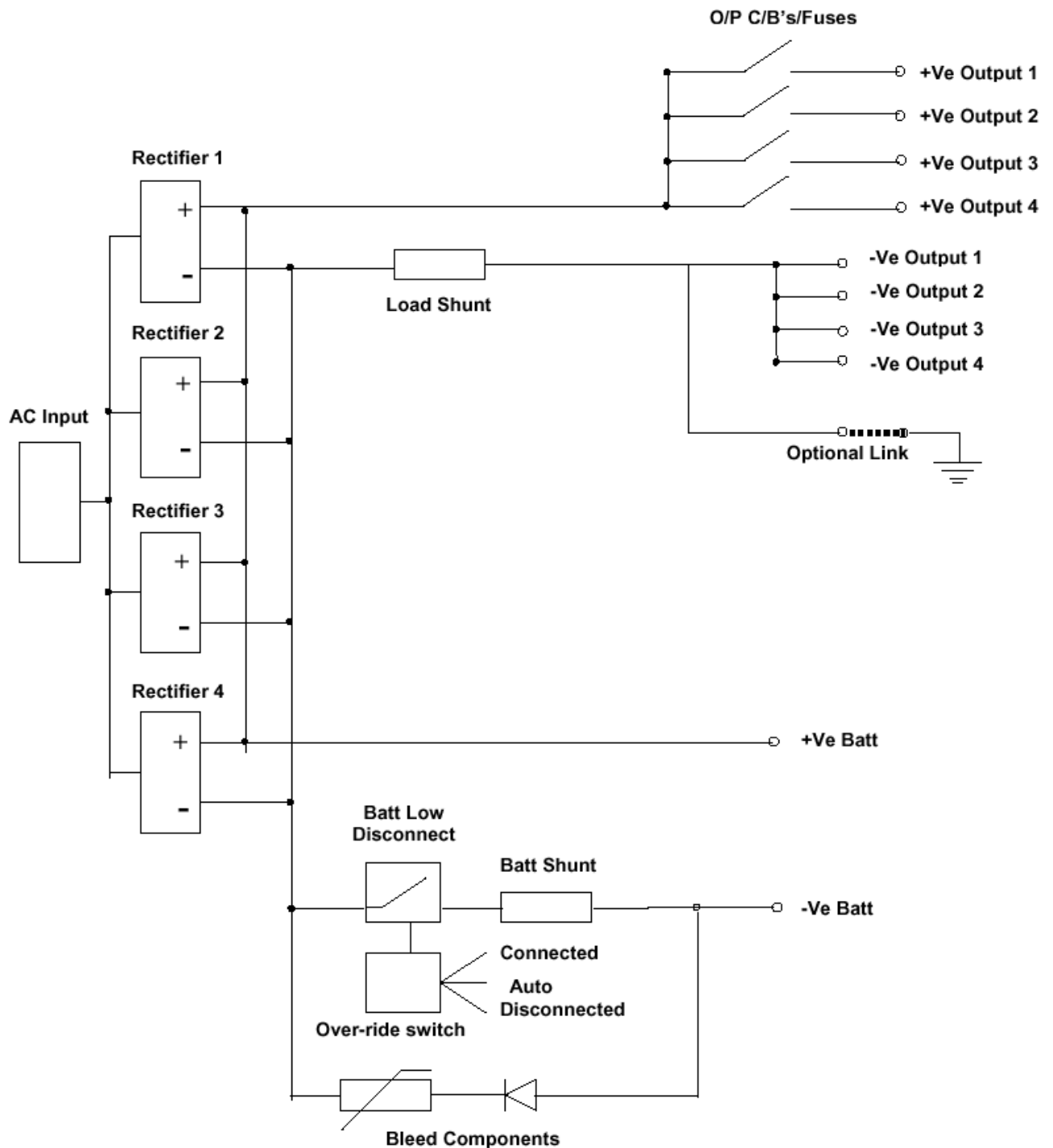


2.7 Schematic

2.7.1 Positive Earth Configured



2.7.2 Negative Earth Configured



3 System Configuration

The MX06 40A shelf is designed to meet a wide range of customer requirements/applications. A number of versions and options are available including various distribution types, alternative input supply configurations, 19 and 23 inch mounting versions, temperature probes etc.

Contact APC for details.

Alternatively the following pre configured systems are available:

DCM00K02W481

Rear access 40A system with 4 x 10A circuit breaker output distribution, includes alarm card with LED display option, 19" mounting brackets, single phase – single feed input, 3 rectifier blanking panels and a non temperature compensated output voltage of 54.5Vdc. Probe for temperature compensation supplied.

DCM00K02W482

Front access 40A system with 4 x 10A circuit breaker output distribution, includes front access alarm card with LED display option, 19" mounting brackets, single phase – single feed input, 3 rectifier blanking panels and a non temperature compensated output voltage of 54.5Vdc. Probe for temperature compensation supplied.

DCM00K02W483

Rear access 40A system with 10 way GMT fuse output distribution, includes a selection of GMT output fuses, alarm card with LED display option, 19" mounting brackets, single phase – single feed input, 3 rectifier blanking panels and a non temperature compensated output voltage of 54.5Vdc. Probe for temperature compensation supplied.

DCM00K02W484

Front access 40A system with 10 way GMT fuse output distribution, includes a selection of GMT output fuses, front access alarm card with LED display option, 19" mounting brackets, single phase – single feed input, 3 rectifier blanking panels and a non temperature compensated output voltage of 54.5Vdc. Probe for temperature compensation supplied.

4 Installation Procedure

4.1 AC Primary Supply

4.1.1 Single Phase

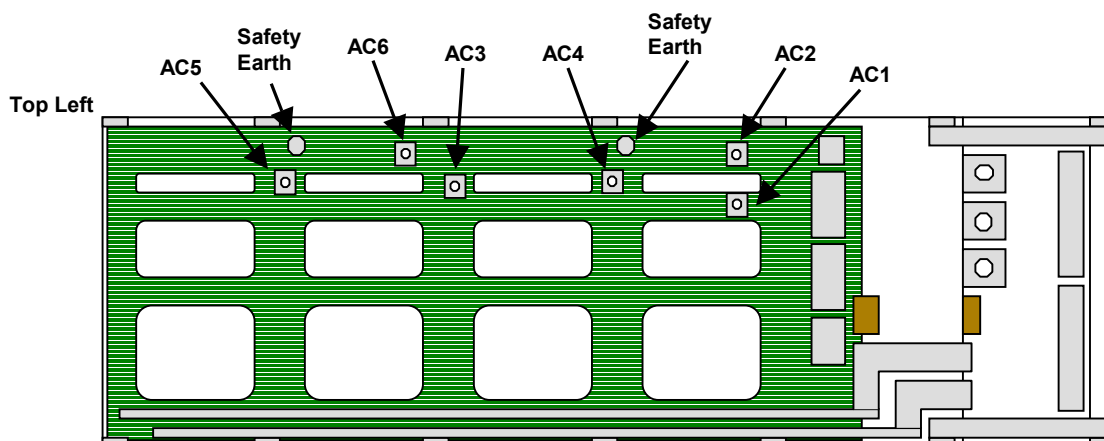
The MX06 40A Shelf can be used on a Single Phase AC supply. The system can be connected to a 230V or 115V supply.

Maximum input current is 26A at 115Vac and 15A at 230Vac. Choose AC Input cabling rated accordingly and colour coded as required for country/state concerned.

4.1.1.1 Rear Access Connection

To connect the input supply to the MX06 40A Shelf proceed as follows:

- The AC input current to the system should also be limited by an appropriate device in the event of a short circuit as defined in **EN60950** to protect the internal wiring of the end use equipment.
- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control. Remove the rear cover to leave the view as shown below.
- There are 3 pairs of AC Input connectors: AC1 (Live), AC2 (Neutral)
AC3 (Live), AC4 (Neutral)
AC5 (Live), AC6 (Neutral)
- Connection can be made to any of the 3 pairs but for optimised EMC performance use AC5 (Live), AC6 (Neutral) and the nearest safety earth stud. Access to this should be through the top left knockout tab. If an alternative knockout is to be used ensure additional insulation is used where cabling passes over secondary parts. NB/ Earth connection should be made first.
- Connect the cables terminated with M4 ring crimps using the M4 x 8 screws supplied in the accessory kit.

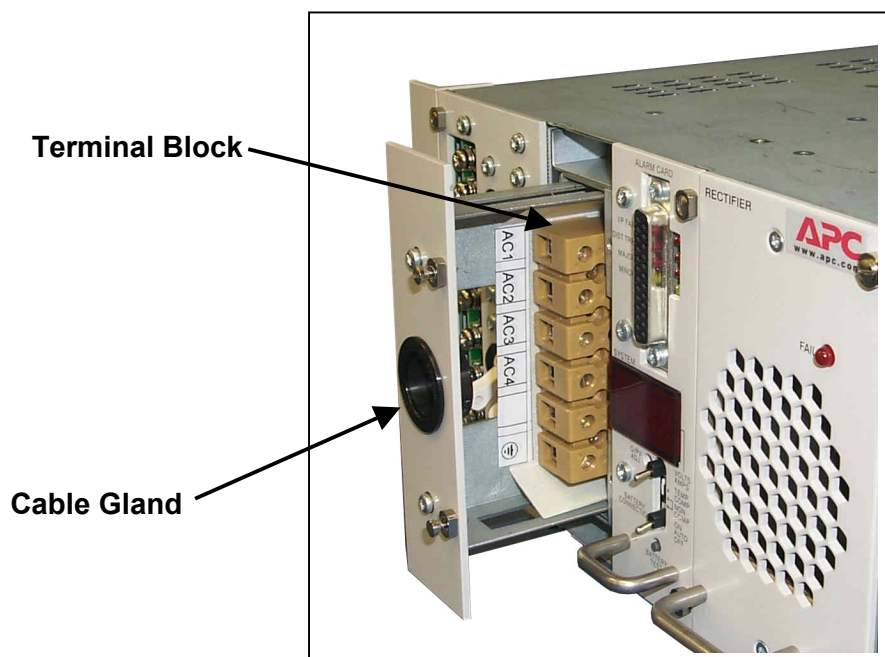


- Cables should be routed as close to the top of the shelf using the supplied routing clips (see section 4.3 for further routing details).
- Refer to section 5 entitled "Commissioning the system" before applying AC power.

4.1.1.2 Front Access Connection

To connect the input supply to the MX06 40A Shelf proceed as follows:

- The same protection devices and cable parameters are required for front access connection as explained for “single-phase rear access” previously.
- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control.
- Strip the ends of the AC Input cables to be connected to the Input terminal block.
- By unscrewing the 2 front panel screws the AC Input connection drawer can be opened as shown below. The AC Input cable is fed through the gland and screwed into the terminal block visible.
- Connect as follows: Safety earth to position marked with earth symbol (connect first)
 Live to AC1
 Neutral to AC2



- The alarm card adjacent to the AC Input drawer may need to be removed for easier access to the terminal block screws.
- A strain relief bush can be fitted instead of the standard cable gland shown. Contact factory for details.

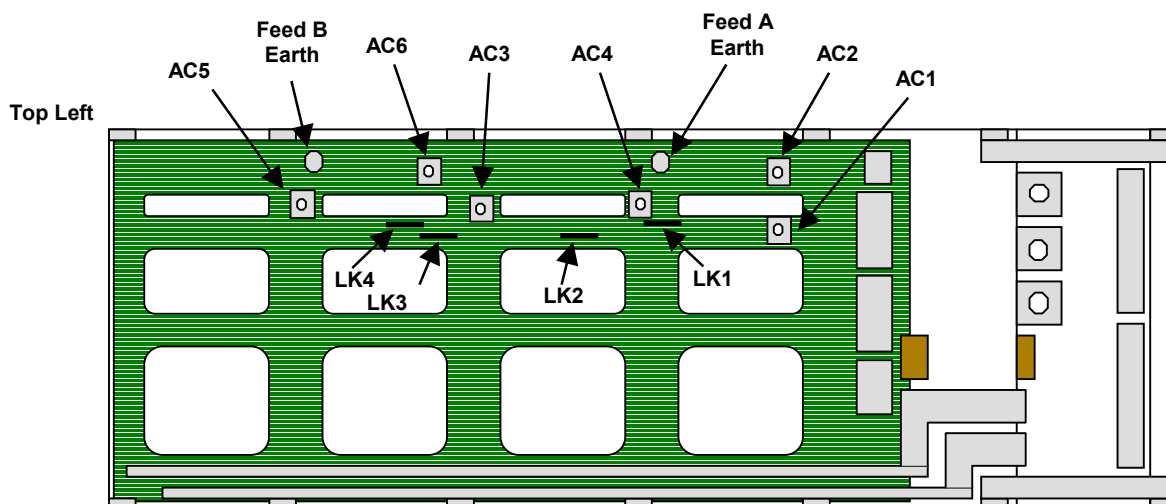
4.1.2 Single Phase, AB Feed

The MX06 40A Shelf can be used on a Single Phase AB Feed system. This means that 2 separate supply's can be used, each powering 2 of the 4 rectifiers fitted. The system can be connected to a 230V or 115V supply.

The maximum input current per feed is 7.5A at 230V and 13A at 115V. Choose AC Input cabling rated accordingly and colour coded as required for country/state concerned.

4.1.2.1 Rear Access Connection

- The AC input current to the system should also be limited by an appropriate device in the event of a short circuit as defined in **EN60950** to protect the internal wiring of the end use equipment. The device(s) should be rated according to the input current as stated above.
- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control. Remove the rear cover to leave the view as shown below
- The main circuit board should have been configured for single phase AB feed use, by removing LK3 and LK4. This is normally factory configured.
- First the two safety earth connections should be connected to the studs labelled below.
- Feed **A** should be wired to: AC1 (Live) and AC2 (Neutral)
- Feed **B** should be wired to: AC5 (Live), AC6 (Neutral)
- Connect the cables terminated with M4 ring crimps using the M4 x 8 screws supplied in the accessory kit.



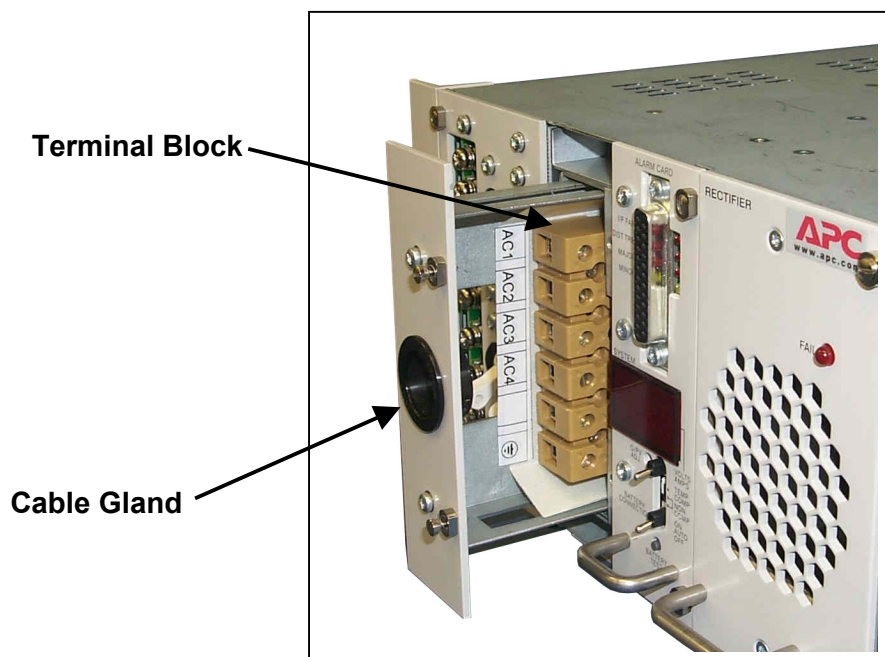
- Cables should exit through the top left knockout tab. If an alternative knockout is to be used ensure additional insulation is used where cabling passes over secondary parts. Cables should be routed as close to the top of the shelf using the supplied routing clips (see section 4.3 for further routing details).
- Refer to section 5 entitled "Commissioning the system" before applying AC power.

4.1.2.2 Front Access Connection

To connect the input supply to the MX06 40A Shelf proceed as follows:

- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control.
- The main circuit board should have been configured for an AB Feed by removing LK3 and LK4. This is normally factory configured.
- Strip the ends of the AC Input cables to be connected to the input terminal block.
- By unscrewing the 2 front panel screws the AC Input connection drawer can be opened as shown below. The AC Input cable is fed through the gland and screwed into the terminal block visible.
- Connect as follows:

Safety earth	to position marked with earth symbol (connect first)
Feed A	Live to AC1
Feed A	Neutral to AC2
Feed B	Live to AC3
Feed B	Neutral to AC4



- The alarm card adjacent to the AC Input drawer may need to be removed for easier access to the terminal block screws.
- A strain relief bush can be fitted instead of the standard cable gland shown. Contact factory for details.

4.1.3 3 Phase Star Supply

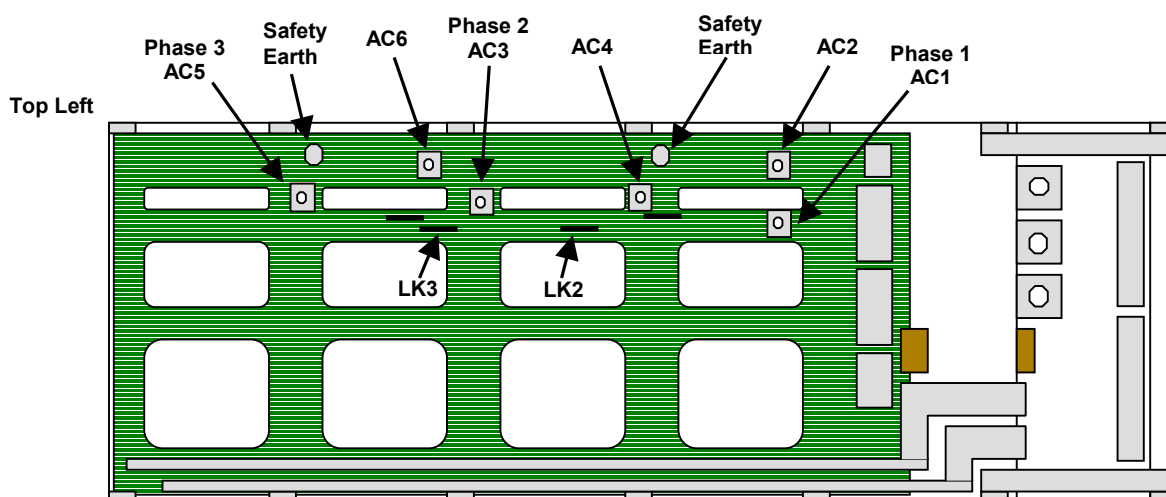
The MX06 40A Shelf can be used on any of the following supplies: 415V, 400V, 380V or 208V phase to phase.

The maximum input current is 13A per phase on a 208Vac phase to phase supply and 7.2A per phase on a 380Vac, 400Vac or 415Vac supply. Choose AC Input cabling rated accordingly and colour coded as required for country/state concerned.

4.1.3.1 Rear access connection

To connect the input supply to the MX06 40A Shelf proceed as follows:

- The AC input current to the system should also be limited by an appropriate device in the event of a short circuit as defined in **EN60950** to protect the internal wiring of the end use equipment. The device(s) should be rated accordingly.
- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control. Remove the rear cover to leave the view as shown below
- The main circuit board should have been configured for 3-phase star use by removal of LK2 and LK3. This is normally factory configured.
- First the safety earth connection should be connected to one of the studs labelled below
- Connect inputs: Phase 1 to AC1, Phase 2 to AC3, Phase 3 to AC5, Neutral to AC2, 4 or 6 (neutral is required as system is a star configuration)
- Connect the cables terminated with M4 ring crimps using the M4 x 8 screws supplied in the accessory kit.

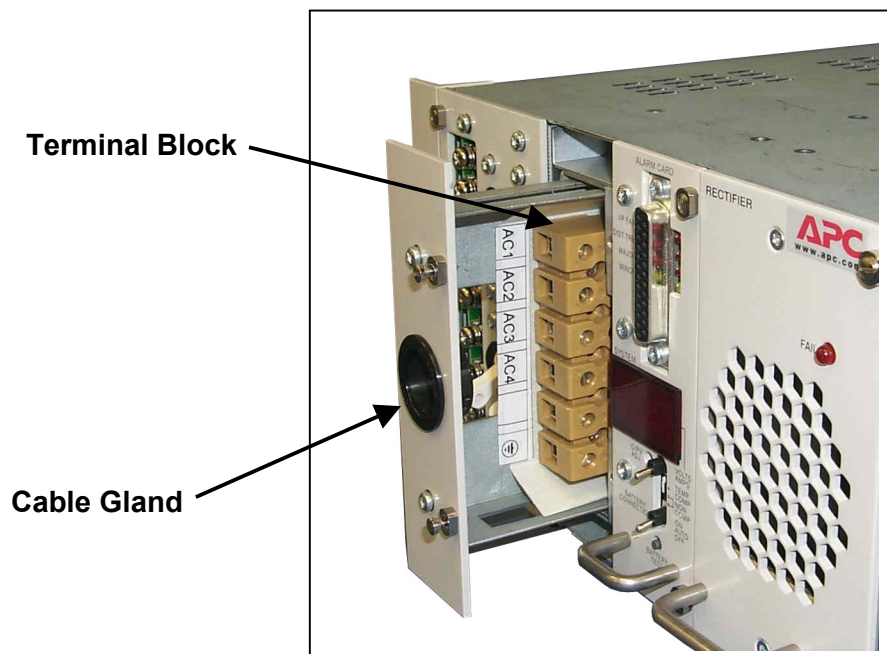


- Cables should exit through the top left knockout tab. If an alternative knockout is to be used ensure additional insulation is used where cabling passes over secondary parts. Cables should be routed as close to the top of the shelf using the supplied routing clips (see section 4.3 for further routing details).
- Refer to section 5 entitled "Commissioning the system" before applying AC power.

4.1.3.2 Front access connection

To connect the input supply to the MX06 40A Shelf proceed as follows:

- The AC input current to the system should also be limited by an appropriate device in the event of a short circuit as defined in **EN60950** to protect the internal wiring of the end use equipment. The device(s) should be rated accordingly.
- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control.
- The main circuit board should have been configured for 3-phase star use by removal of LK2 and LK3. This is normally factory configured.
- Strip the ends of the AC Input cables to be connected to the Input terminal block.
- By unscrewing the 2 front panel screws the AC Input connection drawer can be opened as shown below. The AC Input cable is fed through the gland and screwed into the terminal block visible.
- Connect as follows:
 - Safety earth to position marked with earth symbol (connect first)
 - Phase 1 to AC1
 - Phase 2 to AC3
 - Phase 3 to AC4
 - Neutral to AC2 (neutral is required as system is a star configuration)



- The alarm card adjacent to the AC Input drawer may need to be removed for easier access to the terminal block screws.
- Refer to section 5 entitled "Commissioning the system" before applying AC power.

4.1.4 3 Phase Delta Supply

Warning! The MX06 40A Shelf can only be used on a **208Vac** phase to phase supply.

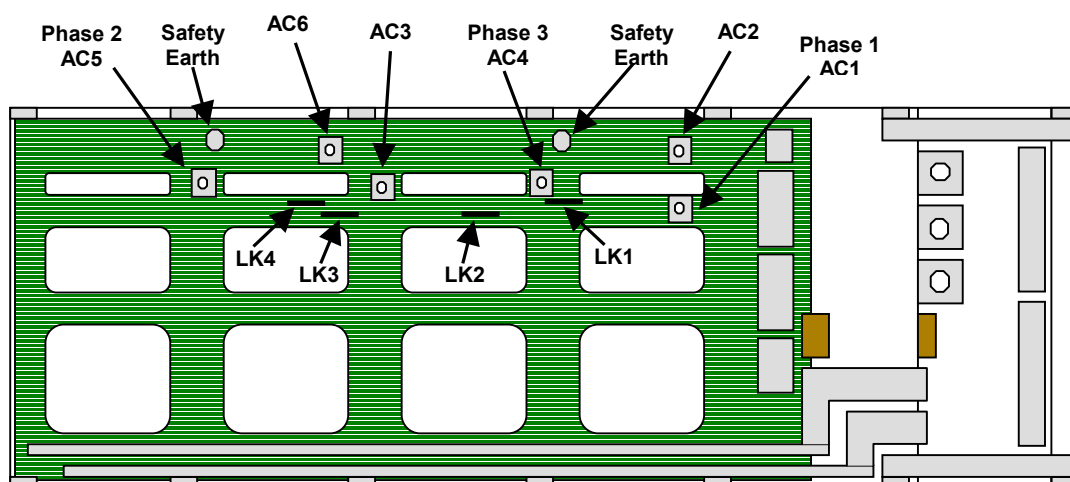
In a delta connection system each rectifier input is connected directly across two phases. Due to the maximum voltage rating of the rectifiers being 264Vac this is the maximum phase-to-phase voltage that can be applied.

The maximum input current on a 208Vac supply is 9.5A per phase. Choose AC Input cabling rated accordingly. The cabling should be colour coded as required for the country/state concerned.

4.1.4.1 Rear Access Connection

To connect the input supply to the MX06 40A Shelf proceed as follows:

- The AC input current to the system should also be limited by an appropriate device in the event of a short circuit as defined in **EN60950** to protect the internal wiring of the end use equipment. The device(s) should be rated accordingly.
- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control. Remove the rear cover to leave the view as shown below.
- The main circuit board should have been factory configured for 3-phase delta prior to sale. LK2 and LK4 should be fitted but LK1 and LK3 should be removed. Also an external link should connect AC2 to AC5. This is normally factory configured.
- Connect as follows: Safety earth to either earth stud (connect first)
Phase 1 to AC1, Phase 2 to AC5, Phase 3 to AC4
- Connect the cables terminated with M4 ring crimps using the M4 x 8 screws supplied in the accessory kit.

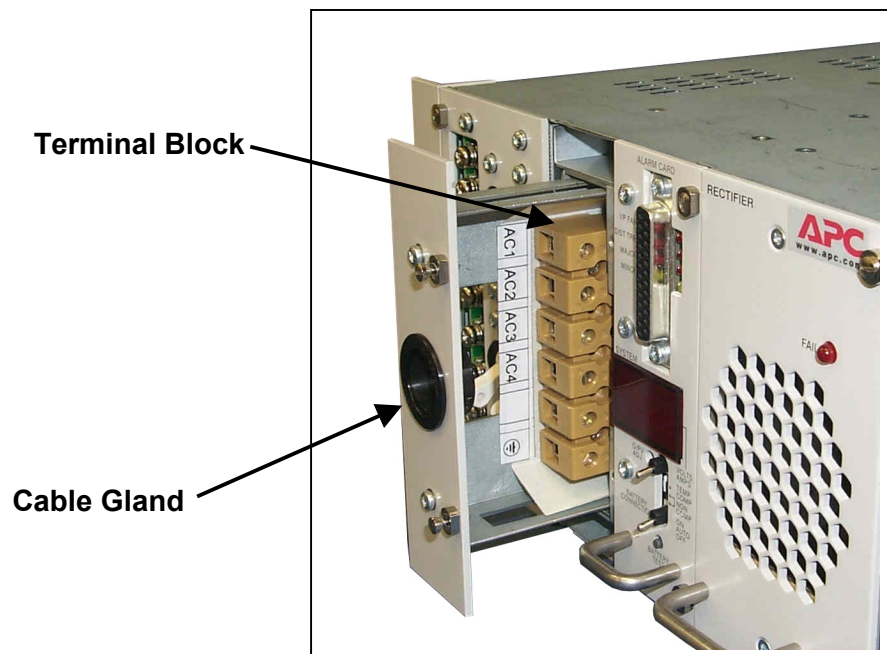


- Cables should exit through the top left knockout tab. If an alternative knockout is to be used ensure additional insulation is used where cabling passes over secondary parts. Cables should be routed as close to the top of the shelf using the supplied routing clips (see section 4.3 for further routing details).
- Refer to section 5 entitled "Commissioning the system" before applying AC power.

4.1.4.2 Front access connection

To connect the input supply to the MX06 40A Shelf proceed as follows:

- The AC input current to the system should also be limited by an appropriate device in the event of a short circuit as defined in **EN60950** to protect the internal wiring of the end use equipment. The device(s) should be rated accordingly.
- Ensure that the AC supply intended for connection is isolated, locked off and under single operator control.
- The main circuit board should have been factory configured for 3-phase delta prior to sale. LK2 and LK4 should have been fitted but LK1 and LK3 should be removed. Also an external link should connect AC2 to AC5. This is normally factory configured.
- Strip the ends of the AC Input cables to be connected to the Input terminal block.
- By unscrewing the 2 front panel screws the AC Input connection draw can be opened as shown below. The AC Input cable is fed through the gland and screwed into the terminal block visible.
- Connect as follows:
 - Safety earth to position marked with earth symbol (connect first)
 - Phase 1 to AC1
 - Phase 2 to AC2
 - Phase 3 to AC4



- The alarm card adjacent to the AC Input drawer may need to be removed for easier access to the terminal block screws
- Refer to section 5 entitled "Commissioning the system" before applying AC power.

4.2 DC Distribution

The MX06 40A Shelf has a DC distribution module fitted. This module contains the chosen distribution components of either circuit breakers or fuses. It also contains an LVD contact (controlled by the controller) and a current shunt measuring load current. The modules can be configured for either positive or negative earthed output. The output can also be left floating to facilitate external grounding. A tripped output will give an alarm displayed as a front panel LED.

There are three standard distribution component types:

- 1/ 10 GMT Fuses
- 2/ 4 Cartridge Fuses
- 3/ 4 Circuit Breakers

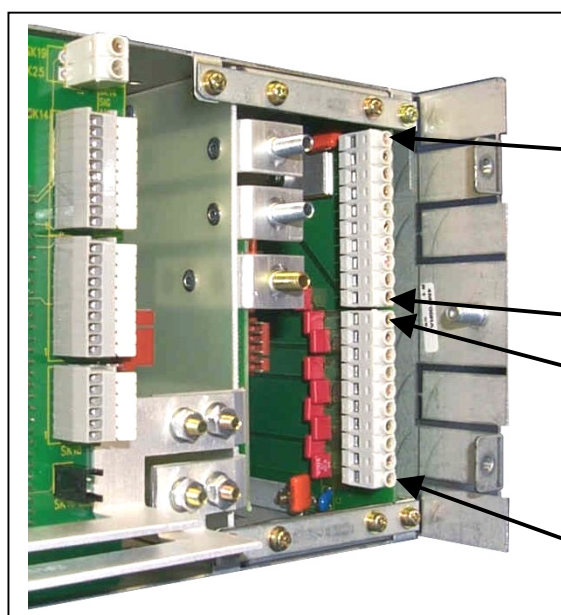
As explained earlier all three types are offered with either front or rear cable access giving six modules types.

4.2.1 10 GMT Fuses Rear Access



No. of Outputs : 10 max
Output Rating : 10A max per output
 (42A total)
Fuses : GMT-** (Bussmann)
Trip Alarm : YES

- Cables should be rated to at least the same current rating as the corresponding output fuse and be colour coded as to meet all the local installation regulations.
- To attach the cables remove the rear cover for access to output connectors.
- Simply strip the ends of the cables and screw into output terminal block.



Output 1

Top Connector :
Common (0V Return) / Earth (if link fitted)

Output 10

Distributed Output 1

Bottom Connector :
- 54Vdc (when positive earthed)

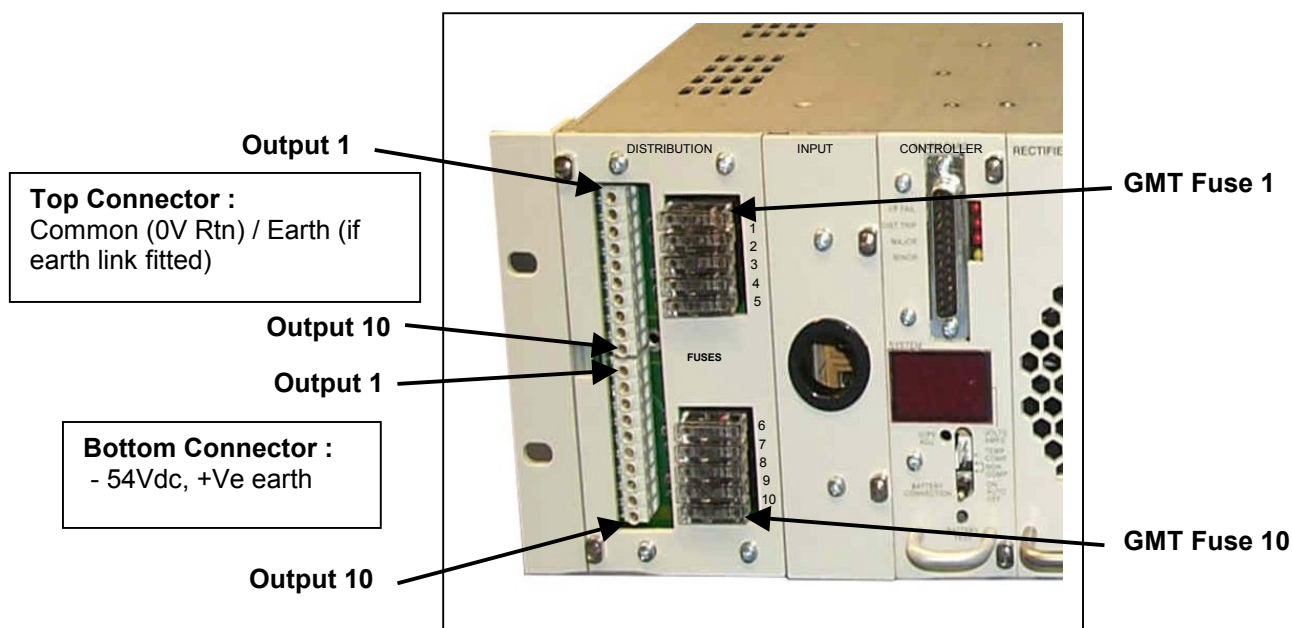
Distributed Output 10

4.2.2 10 GMT Fuses Front Access

No. of Outputs : 10
Output Rating : 10A max per output
 (42A total)
Fuses : GMT-** (Bussmann)
Trip Alarm : YES

To connect the cables to the system proceed as follows:

- Cables should be rated to at least the same current rating as the corresponding output fuse and be colour coded as to meet all the local installation regulations
- Remove the distribution front panel to give easier access to terminal block if required. To attach the cables simply strip the ends and screw into output terminal block
- Ensure stray wires do not contact the front panel metalwork.



GMT Fuse ratings

Continuous Current Rating	Ambient Temperature			
		20°C	50°C	65°C
	10A	7A	6A	5A
	12A	8A	7A	6A
	15A	10A	9A	8A

This table shows that the continuous current rating of a GMT fuse is less than the specified current rating. It also shows that it is affected by ambient temperature.

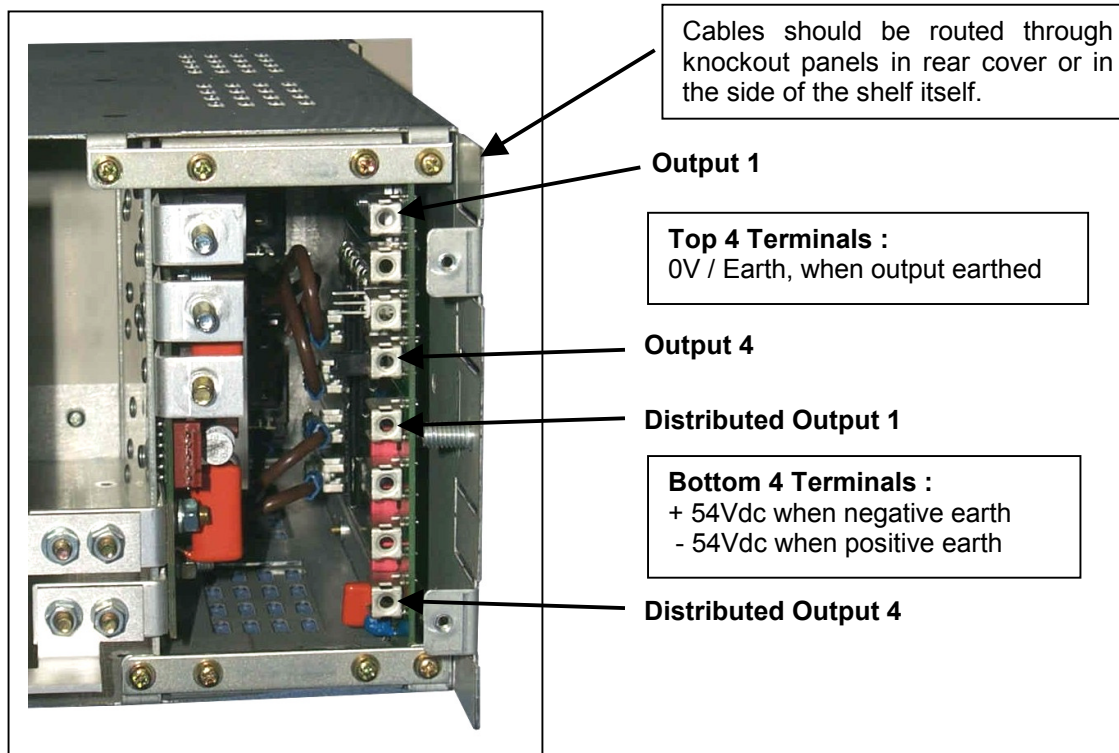
Lower value fuses follow the same pattern.

4.2.3 4 Circuit Breakers Rear Access



No. of Outputs : 4
Output Rating : 4 O/P's up to 20A max
 2 O/P's up to 40A max
 1 O/P up to 50A max
Circuit Breakers : Series DC Current trip,
 Medium time delay.
Trip Alarm : YES

- Remove the rear cover to give access to the output terminals (shown below).
- To connect to the output terminals use M4 ring crimps with cables rated to at least the same current rating as the corresponding output breaker and colour coded as to meet all the local installation regulations.



4.2.5 4 Cartridge Fuses Rear Access

No. of Outputs : 4
Output Rating : 4 O/P's up to 20A max
 2 O/P's up to 25A max
 1 O/P up to 25A max
Fuses : Bussmann NITD range
Trip Alarm : YES

To connect the cables to the system follow the same procedure as for the "4 Circuit Breaker Rear Access" distribution module (section 4.2.3).



4.2.6 4 Cartridge Fuses Front Access

The ratings are the same as for the rear access version above.

To connect the cables to the system follow the same procedure as for the 4 Circuit Breaker Front Access distribution module. (see section 4.2.3)



Note/ to gain access to the fuses remove the distribution front panel (front and rear access versions)

4.3 Routing Of Cables

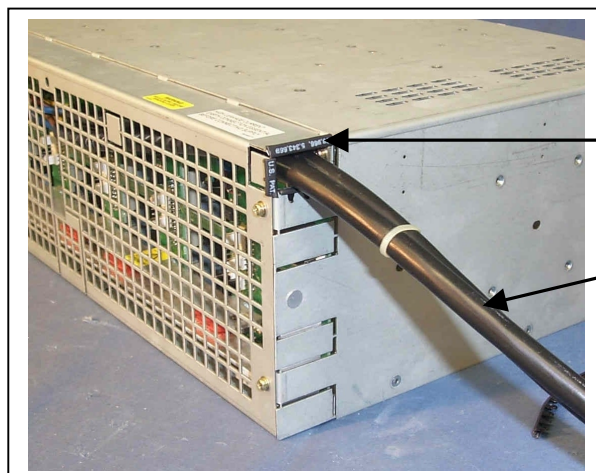
4.3.1 Input cables

One or more of the top 3 knockouts (top left hand side knockout and 2 actually in the rear cover) must be used for entry of the input AC cable. This is essential if the input cabling used is not double insulated and recommended as this optimises the EMC performance by ensuring the AC Input cables are as far away from the output wiring as possible. Cables should be routed as near the top of the system as possible using the cable clips provided, with big loops of cable inside the shelf being avoided.



300mm of cable protector grommet strip supplied. Simply cut into required lengths and fit around edge of knockout holes (as shown below)

Top 3 Knockouts

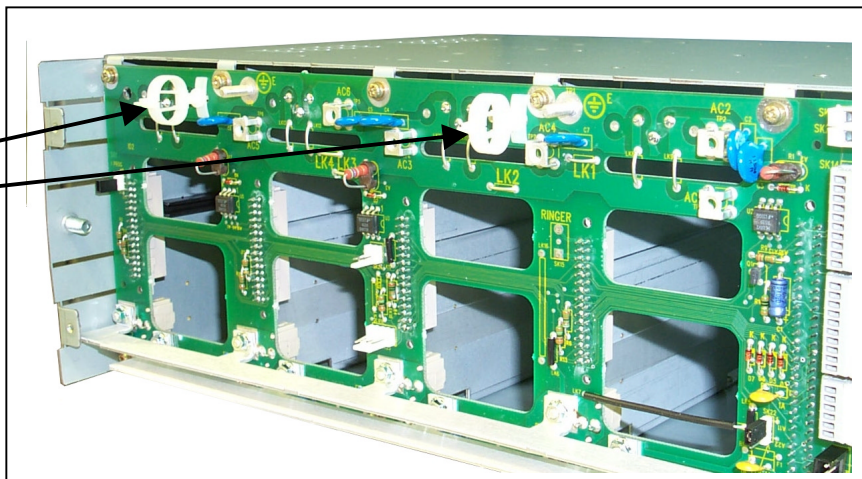


Cable protector grommet

AC Input Cable

Note/ This picture does not show a 40A Shelf and is to be used only as an example of how to use the grommet strip as cable protection.

Supplied cable clips for routing of input cables



4.3.2 Output Cables

The output cables may be of quite large diameter and therefore it may be necessary to use more than one knockout hole. The right hand side knockouts should be used to keep the output cables physically as far from the input cables as possible to optimise EMC performance.

4.4 External Battery Installation

4.4.1 Battery Back-up function

Battery backup may be achieved by connecting 48V strings of batteries onto the external battery terminals of the distribution module at the rear of the system. This battery string will be connected to the system bus voltage via an internal LVD contact. If for any reason the rectifier outputs are not present, either by component failure or by the loss of AC power then the battery string can supply the load for a limited time.

4.4.2 LVD Function

An internal LVD contact is fitted for battery string protection. Its function is to connect or disconnect the battery string from the system bus. The LVD can be set to “ON”, “AUTO”, or “OFF”. In the On position the batteries are connected to the system bus. In “Off” the connection is broken. In “Auto” the batteries are connected to the system bus under normal system running conditions. If the system bus voltage falls the battery string will supply the load. If the battery voltage then falls below 42Vdc the LVD contact opens and disconnects the batteries to protect them. When system bus voltage is re-established the battery string will be trickle charged until the battery voltage is >50Vdc and then the batteries will be reconnected to the system.

4.4.3 Installation procedure

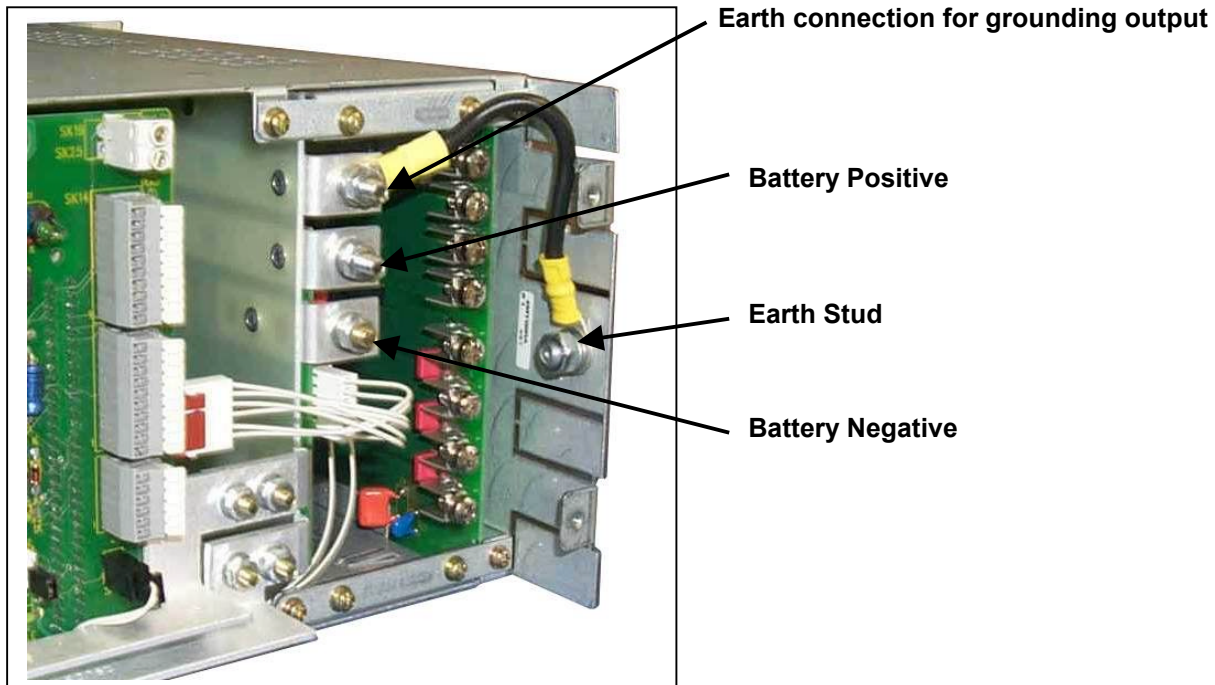
!!! CAUTION !!!

Only connect external battery strings of 48V to the MX06 40A Shelf.
External batteries **MUST** have circuit breakers fitted at source.
Observe the polarity of the external battery connector.
See section 4.3.4 for connection photo.

Note : It is possible to connect external battery strings of different capacities but the backup duration will be affected.

- Ensure the battery breaker/s for the external batteries are in the ‘OFF’ position before connecting external batteries.
- Set the front panel “battery connection” switch to “OFF”.
- Choose cables rated at 50A and colour coded to meet local installation regulations.
- Cables should be crimped with M5 ring crimps for connection to system battery terminals.
- Connect battery string to system ensuring correct polarity of connection.
- Conduct a final check before turning on the external battery breaker.

4.4.4 Battery Connection Diagram



4.5 System Output Earthing

The MX06 40A Shelf has its output earthed as default. The output is earthed by the earth cable joining the earth stud to the output earthing bus-bar (as shown in the above picture). The earth link can be removed to leave the output floating but the user must then earth the output at some other point in the system.

The default configurations are as follows:

54 V systems are set to earthed positive output
27 V systems are set to earthed negative output

5 Commissioning the System

5.1 General

All site preparation and equipment installation in the previous chapters must be completed before commissioning.

- Ensure that the AC power source isolator is switched OFF.
- Switch all MX06 40A Shelf and any external battery circuit breakers to the OFF position.

5.2 Powering up the MX06 40A Shelf

- Set the required alarms to show a “Major” or “Minor” alarm. To do this remove the alarm card from the shelf and operate switches SW2 and SW5 (see section 2.3.4)
- Switch on the external ac power supply to the MX06 40A Shelf.
- Check the Rectifier module LED's:
- Check that each rectifier module has 2 green LED's lit (if fitted), representing Input Healthy and Output Healthy. There should be no red LED's lit.
- Check the alarm card LED's:
- The alarm card has 4 LED's (3 red and 1 yellow) the only LED that may be lit is the red “Dist Trip” which will be lit if the system has output circuit breakers that are turned off. The other LED's should be off unless “Major” or “Minor” have been allocated to “Dist Trip”.
- Set alarm card meter to read “Volts” and check that the output volts are set to the desired level. If the voltage is slightly higher or lower than required simply adjust using the alarm card front panel potentiometer (see section 2.3.1). **If the output voltage is outside the specified range this may indicate a fault.**
- Switch on the Distribution Breakers (1, 2, 3 and 4 as required) if fitted.
- Ensure the correct polarity of any connected battery strings (see section 4.4.4) then switch on any external battery breakers as required.
- Switch the “Battery Connection” switch to the desired setting “ON”, “AUTO” or “OFF” (see section 4.4.2)

6 Manual Handling Procedure

6.1 General

6.1.1 Items within the sub-system present a hazard due to mass. A fully configured system fitted with 4 rectifiers weighs almost 15Kg.

6.1.2 The Manual Handling of Loads Regulations, 1993 require that all persons working on the equipment are familiar with the Regulations, that they take care to minimise risk of injury to themselves and others, that they are properly trained, and that the correct equipment is used. Safety shoes are to be worn.

6.1.3 If in doubt about methods, ability to handle the loads, training or equipment, do not proceed without first seeking advice from a competent person.

6.2 Preparation

6.2.1 Before commencing work check the following:

The floor is level, clean, firm and dry.

The working area is clear of obstacles that could obstruct movement or cause tripping.

There is adequate room for the operator(s), equipment and load.

The lighting is sufficient for the load, equipment, loading surfaces, potential hazards and working environment to be seen clearly.

Sound levels are not too high to cause distraction.

6.3 Method

6.3.1 The following is not intended to replace other documents and training courses, only to serve as a guide and checklist. For full guidance refer to the Regulations and supporting documents.

6.3.2 Before lifting, stand as close as possible to the load.

6.3.3 Keep the back straight and as vertical as possible.

6.3.4 Use the leg muscles in preference to the arms.

6.3.5 Minimise twisting, stretching and stooping.

7 Fault Finding / Symptoms

The sub-system is designed for maximum reliability and therefore faults during normal operation are unlikely. If faulty operation does occur the source of the failure can usually be readily determined by inspection of the LED meter and the LED's.

7.1 Warnings

POTENTIALLY LETHAL VOLTAGES AND SOURCES OF HIGH ENERGY ARE PRESENT WITHIN THE POWER SYSTEM. EXTREME CAUTION MUST BE OBSERVED AT ALL TIMES. ACCESS TO THE INTERIOR OF THE SYSTEM FOR INSTALLATION, COMMISSIONING, MAINTENANCE AND REMOVAL AND REPLACEMENT PURPOSES IS LIMITED TO FULLY TRAINED SERVICE PERSONNEL ONLY.

RINGS, WATCHES AND JEWELLERY SHOULD BE REMOVED AND ONLY SINGLE ENDED INSULATED TOOLS SHOULD BE USED WHEN WORKING OR MAKING MEASUREMENTS INSIDE THE SYSTEM. A SOLDERING IRON MUST NOT BE USED UNLESS THE INPUT, OUTPUT AND BATTERY (IF CONNECTED) HAVE FIRST BEEN ISOLATED.

7.2 Fault Symptoms

Typical fault symptoms and their possible causes are shown in table below. If the fault cannot be diagnosed contact the manufacturer.

SYMPTOM	POSSIBLE CAUSE(S)
Output voltage is zero at load	<ol style="list-style-type: none"> 1. Failure of AC supply. 2. Distribution device(s) tripped (check dist trip LED). 3. Failure of external disconnect device.
All Rectifiers Input Healthy LED's are lit (4 LED rectifiers) or Rectifier Fail LED not lit (single LED Rectifier) but system bus voltage is zero (LED display extinguished).	<ol style="list-style-type: none"> 1. Rectifiers have tripped due to over-voltage. 2. System output not enabled, could be set to remote enable instead of local enable. (see section 2.5.4)
One or more rectifiers "output healthy" LED is extinguished temporarily (4 LED rectifiers). Or one or more "Rectifier Fail" LED lit temporarily (single LED Rectifier).	<ol style="list-style-type: none"> 1. Rectifiers tripping due to over temperature condition, (Local ambient may be above rated level). (see section 2.1.1)
One or more rectifiers output healthy LED extinguished (4 LED rectifiers). Or one or more "Rectifier Fail" LED lit (single LED Rectifier).	<ol style="list-style-type: none"> 1. System in overload condition (check current limit LED's). 2. System tripped due to over-voltage condition (check rectifier over-voltage LED's).
Battery String not connected to system.	<ol style="list-style-type: none"> 1. Battery connection switch set to "off". 2. Battery connection switch set to "auto" and battery string voltage below LVD level (see section 4.4.2) 3. System output voltage is below low voltage reconnect level.
Battery string doesn't disconnect when voltage drops below LVD level.	<ol style="list-style-type: none"> 1. Battery disconnect switch set to "on" instead of "auto" (see section 4.4.2)

8 Service, Accessories & Spares

8.1 Rectifier replacement

If a faulty rectifier is to be replaced simply unscrew the two front panel fixings on the rectifier front panel and withdraw the rectifier from the shelf. A replacement rectifier can then be inserted directly into the shelf and will start-up automatically.

Note – The rectifiers are “hot plugable” and therefore can be replaced without turning the system off.

8.2 Controller replacement

If the alarm card is to be replaced simply unscrew the two front panel fixings and withdraw the module from the shelf. A replacement module can then be inserted directly into the shelf and will start-up automatically.

Note - with the module removed the system will revert to default rectifier conditions of 54.5V. Some alarms and all control functions will be unavailable including battery monitoring.

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